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ABSTRACT

Triton College, under the auspices of a National Science Foundation grant, has designed a team taught course combining an engineering and rhetoric course in which students are introduced to the engineering profession and its communication techniques. The instructional technique is multi-faceted, integrating simulation of the professional environment with course content through the use of case studies, contract learning, speakers, and field experiences. In addition, computer managed testing and games dealing with clarification of values and professional ethics are used. This research supports the concept that a methodology which systematically incorporates a variety of learning/teaching approaches is successful, cost-effective, and transferable. (Author)

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A MULTI-TECHNIQUE APPROACH FOR EFFECTIVE LEARNING

by

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A MULTI-TECHNIQUE APPROACH FOR EFFECTIVE LEARNING

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Abstract

Effective learning demands a critical alignment of learning and teaching styles. Research indicates this alignment can best be accomplished by developing a course which offers students more than one or two means of reaching course objectives.

Triton College, under the auspices of a National Science Foundation grant, has designed a team taught course combining an engineering and rhetoric course in which students are introduced to the engineering profession and its communication techniques. The instructional technique is multi-faceted, integrating simulation of the professional environment with course content through the use of case studies/contract learning, speakers, and field experiences. In addition, computer managed testing and games dealing with clarification of values and professional ethics are used.

Our research supports the concept that a methodology which systematically incorporates a variety of learning/teaching approaches is successful, cost-effective and transferable.

Introduction

Universities have traditionally fulfilled the role of centers of learning. Approximately 150 years ago in the United States, the universities also assumed an increasingly stronger role in career

preparation. The marriage of the two has been, at best, tentative and uncomfortable. Curricula which lead to professional careers, particularly in the sciences, dogmatically include a set number of elective humanities courses to provide the student with a liberal education. That liberal education, however, is often seen by students, instructors and administrators, as a requirement separate and secondary to the goal of career preparation.

Students caught in this fragmented curricula, then, are impatient to be rid of those "impractical" humanities courses. "The acquisition of knowledge is a fairly straightforward process provided the individual wants the new knowledge. The motivation of an individual - his 'felt need' for new knowledge or increased skills - are absolutely critical factors in any learning."[1] To provide a broad-based education, to motivate students toward the goal of a liberal education, and to match education needs as perceived by students, those humanities courses which have potential relevance to professional development should be modified and included in any curriculum of career preparation.

Course Development

The course developed at Triton College is a combination of a traditional three-hour rhetoric course coupled with a one-hour introduction to engineering course. Standard rhetorical principles have been applied to technical formats and technical content. Thus, at the beginning of a college career, the student is introduced to the interrelationships of the humanities and technology. Furthermore,

the course demonstrates the applicability of a non-major course, English composition, to engineering.

The assignments in the team taught course are shown in Fig. (1).

Assignment	Writing	Listening	Speaking
Abstract	x		
Description	x		
Ethics	x	x	x
Formal Report	x		
Interview	x	x	x
Oral Report			x
Persuasive Essay	x		
Proposal	x		
Science Fiction/Fantasy	x		
Speakers/Abstract	x	x	
Videotapes/Abstract	x	x	

FIG. (1) - COURSE ASSIGNMENTS

The combined course has been taught for four years. At the end of each semester, student and faculty responses were analyzed both informally and with a 181 item questionnaire[2]. In addition, learning styles of students in all sections were thoroughly studied through two standard questionnaires. The student profile formed the basis of continual course development and modification.

Student Profile

In order for teaching to be effective, the learning characteristics of students must be known. Today's college students present wide ranges in age, high school preparation, socio-economic backgrounds, and aspirations. This range is accentuated by the open-door admission policy of a community college such as Triton. While teachers perceive and respond to general trends in the classroom, in this course we attempted to define the student's individual characteristics and to develop instructional strategies which responded to the student's specific learning style. Standard tests were used to develop the student profile.

The Strong-Campbell Interest Inventory (SCII)[3] was used to determine vocational interest. The SCII gives the respondent three main types of information: first, scores on six General Occupational Themes, which reflect the respondent's overall occupational orientation; second, scores on 23 Basic Interest Scales, which report the consistency of interests or aversions in specific areas such as art, science or public speaking; and third, scores on 124 Occupational Scales, which indicate the degree of similarity between the respondent's interests and characteristic interest of men and women in a wide range of occupations.[4]

Results of the test showed the following predominant characteristics for the experimental group:

GENERAL OCCUPATIONAL THEMES (Scale: 1-very low; 7-very high)

Realistic - 4.7	Enterprising 3.8	Artistic - 3.4
Conventional - 4.1	Investigative - 3.8	Social - 2.7

OCCUPATIONAL ORIENTATION

Data - 6.2	People - 2.6	Learning Ability - 4.3
Things - 4.1	Numerical Ability - 5.0	Verbal Ability - 4.0

ACADEMIC ORIENTATION

Yes - 42%	Either - 34%	No - 24%

INTROVERSION-EXTROVERSION SCALE

Work Alone - 36%	Either - 62%	Work in Groups - 2%

OCCUPATIONAL SCALE - ENGINEER

Very Low - 0%		
Low - 5%	Average - 52%	High - 25%
		Very High - 18%

FIG. (2) - RESULTS OF STRONG-CAMPBELL INTEREST INVENTORY

The student learning styles were investigated through two instruments: The Canfield Learning Styles Inventory (CLSI)[5] and a modification of the Gregorc Information Acquisition Inventory.[6] The Canfield Learning Styles Inventory "has been devised to measure some of those affective variables that seem to affect learning, and which contribute to satisfactory and effective adjustment to the teaching-learning situation.[7] The four major areas within which measures are made are:

1. Conditions - the major motivational areas of affiliation, eminence, structure and achievement;
2. Content - the fields of interest;
3. Mode - the specific modality through which a student learns best;
4. Expectation - the nature of expectations for performance.

The two instructors in the course, Debs (English) and Brillhart (Engineering), completed the inventories to assess their learning styles. Results of the Learning Styles Inventory are given in the following figure:

CATEGORY	High %	Average %	Low %	ACTIVITIES
	B-Brillhart D-Debs			
nditions:				
Peer Affiliation - Need for opportunity to establish friendly relationships with individuals and with group	38	40_D	22_B	Small Group discussions, team projects, cooperative study.
Organization Structure - Need for information about sequence and logic of events.	19_B	52	29_D	Course outlines and study guides; few diversions into unrelated topics.
Goal-Setting Achievement - Need for setting one's own objectives and goals	$15_{D/B}$	52	31	Setting time and length limits on work; options within any assignment.
Competition Eminence - Need to compare performance with others	31_B	50	19_D	Competitive activities, awarding points for performances.
Instructor Affiliation - Need to get to know instructor personally	24	50_D	19_B	Informality in classroom, private-helpful tutoring.
Detail Structure - Need to know precise expectations.	36	50_B	14_D	Written information about assignments, detailed evaluative criteria.
Independence Achievement - Desire to work alone.	$19_{B/D}$	55	26	Independent study, out-of-class work, non-group activities.
Authority Eminence - Desire for well-controled learning environment and clear-cut utilization of osition power.	31_B	38_D	31	Lectures by recognized authorities.
Content:				
Numeric - Preference to work with computations, numbers and mathematical manipulations	55_B	43_D	2	Study units involving mathematics on some form of logical system analysis or computation.
Inanimate - Preference to work with things; repair, design, or operation of equipment	21_B	19_D	10	Simulations; activities involving working models, pieces of equipment.
People - Preference for activities involving other people	14_D	33	53_B	Discussion topics on human relations or human resource management.
Qualitative - Preference for dealing with words (qualitative symbols).	17_D	52	31_B	Open-ended discussions, debates.
Mode				
Listening	21_B	55	24_D	Lectures, audio tapes, discussions.
Direct Experience	4	45_B	14_D	Simulating, experiments, field visits, role plays.
Iconic	10	73_D	17_B	Movies, demonstrations, videotape feedback
Reading	24_D	43	33_B	Conventional readings, case studies.

FIG. (3) - RESULTS OF CANFIELD LEARNING STYLES INVENTORY

The Gregorc Information Acquisition Inventory is an instrument used to assess methods of learning; information acquisition is then divided into four areas: concrete experience, abstract conceptualization, reflective observation and active experimentation.[8] By rephrasing the statements in the inventory, we modified this instrument to assess students' perceptions of their information acquisition systems specifically within a composition course.

The results of this inventory are graphically represented as follows:

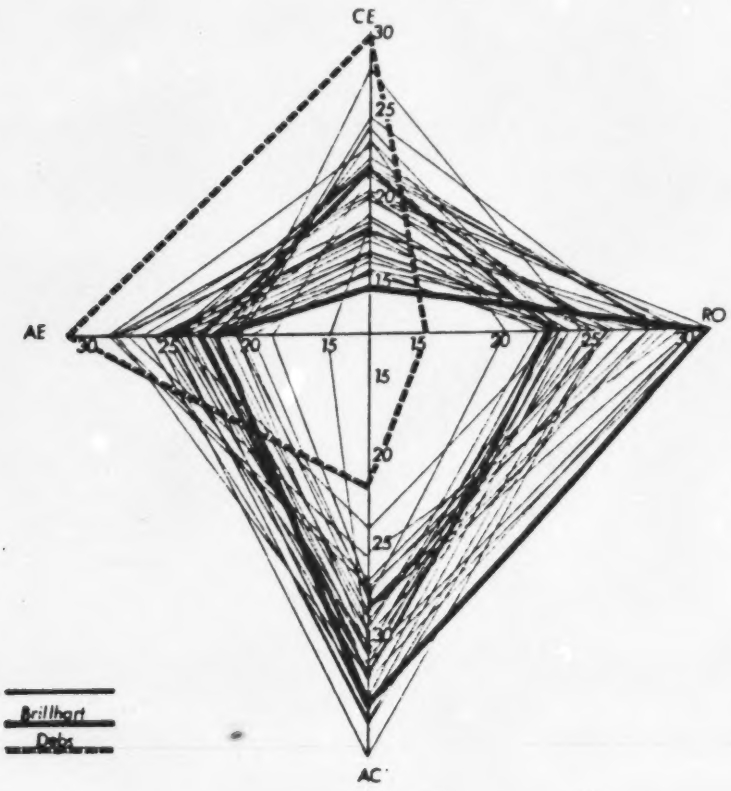

FIG. (4) - RESULTS OF ADAPTED GREGORC LEARNING STYLES INVENTORY
ENGINEERING GROUP A

It should be noted that the two instructors of the combined course also completed both inventories. Assuming there is a direct correlation between an individual's teaching style and his preferred learning style, the results of the Gregorc Inventory dramatically reveal how two instructors from separate disciplines can effectively bracket the students' own systems. Results of the Canfield Inventory also support this finding.

Finally, the students' academic preparedness was gauged by means of scores from the ACT Examination (American College Testing Program)[9]. The ACT is a vehicle for predicting academic performance in four-year colleges and universities. The multiple choice instrument tests aptitudes in four content areas. Developed over 20 years ago, the ACT test is currently used by approximately 80% of the colleges in the United States. Mean scores of the experimental group are represented as follows:

	MEAN ACT SCORES				
	ENGLISH	MATH	S.S.	N.S.	COMP.
Engineers	17	21	18	23	21

FIG. (5) - ACT SCORE COMPARISONS

The scores for engineers are significantly higher than the mean scores for all college students. High school rank was not used as a predictor of academic performance because the quality of high schools varies significantly.

Discussion

Since the testing indicates not only definite characteristics of engineering students but also a wide range of learning styles and competencies, a multi-technique approach was chosen. This approach utilizes the students' learning preferences and strengths as a basis in designing the content and structure of the course. Thus,

while an English instructor in a traditional composition course has difficulty motivating students who prefer numerical and abstract manipulation to the exclusion of writing skills, in the combined rhetoric/introduction to engineering course that proverbial problem is converted into an advantage. Students' enjoyment of data analysis is encouraged and becomes the impetus for communication skills building. In addition, writing is taught as a process, one which is also highly analytical. The wide range of student characteristics is accommodated by at least 25 writing assignments and 36 related activities, varying in condition, mode, content and performance expectation. The combined presence of two faculty members from diverse backgrounds accentuates the mixture of teaching/learning styles.

The most successful component of the course is the proposal and formal report. Every semester, an engineering-related problem not requiring professional expertise is chosen. Each student writes a proposal bidding to investigate a component of the problem. If the proposal is found to be meritorious, a contract is initiated for the investigation of the problem. Students, then, in groups or individually, gather data about the problem to investigate possible solutions. During the course of the contract, students are introduced to the process of writing a formal report, i.e., audience analysis, style, format and mechanics. Frequent progress checks insure continued mastery and instructor affiliation. The success of the report is evidenced by faculty and consultant evaluation of the student product.

The report satisfies the strong need for peer affiliation, but does allow independent achievers a viable option. Since the project relies on data manipulation, a consistently high score on the SCII and SLI tests, writing - a low interest score (see Figs. 2 and 3) - becomes acceptable, even challenging. Students show a ten-

dency to prefer learning through the modes of listening and direct experience (see Fig. 3). These are the frequently employed methods in data acquisition and reduction.

The results of the occupational scale in the SCII test indicates that most of the students have an average to high similarity to engineering profiles (see Fig. 2). To enhance this, a series of speakers representing various disciplines and job functions in engineering are invited to the classroom to discuss their work. Furthermore, to satisfy those students who have preference for authority eminence (see Fig. 3), discussions by nationally recognized engineers are videotaped and viewed in class.

To further the goal of introducing students to their chosen career, direct experience (see Fig. 3) is incorporated in the course by means of personal interviews with practicing engineers at a job site. This activity also generates a writing assignment. Thus, a variety of communication skills are successfully incorporated through the semester.

Since the course still must meet all of the standard parameters of a rhetoric course, vocabulary development is included. Vocabulary testing is a computer-managed, random-selection, multiple-choice quiz. The CMI meets two goals: students are introduced to computer utilization and mastery learning is accomplished at rates appropriate to each student. The computer as a testing device is particularly appropriate for students who like to manipulate things but not words. (See Fig. 3).

Since students are planning to enter a profession and not a trade, ethics must be

incorporated. This is done by means of values clarification games, which deal with actual issues in engineering. For example, students analyze failures that have occured due to poor judgement by engineers. Again, peer affiliation and small group affiliation opportunities are provided (see Fig. 3).

The structure of this variegated course is maintained by means of stringent sequencing activities. Students at all times are aware of expectations and all evaluative criteria. Feedback is continuous. Tutoring, formal or informal, depending on the individual's preference, is always available. Students may pursue individual paths of learning with no penalty for learning style preference.

Conclusions

As a result of this multi-technique approach, students are doing more willingly and more students are meeting high standards of competencies. The final evaluation instrument included questions to assess students' attitudes towards the course. Results showed the students consistently rated the course among the highest 20% of courses ever taken, even though they rated it as requiring more writing than any other course they had ever taken.

We also found that engineering students with either very high or very low ACT scores did markedly better in the sequential second semester rhetoric course than engineering students with similar ACT scores who had taken a standard first semester rhetoric course.

The team-taught course requires no additional personnel nor does it require exceptional expertise on the part of participating faculty. Hence, this type of course can readily be taught by an English instructor with a teacher from any

professional discipline. Our experience has shown that if both faculty members are willing to adapt their teaching methods to a variety of learning styles, the resulting flexibility produces greater achievement by students.

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